Preparing culturally responsive elementary science teachers: The SCI-Bridge model

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Abstract

Historically, the public education community has struggled with providing all children with equitable access to quality science education; particularly in urban communities. Teachers play a vital role in addressing this challenge. By equipping them with the pedagogical knowledge needed to employ culturally relevant/responsive practices, teachers will be better prepared to address the challenges related to broadening participation in science. *SCI-Bridge* is a teacher development project that seeks to address inequities in access to quality science instruction in urban elementary schools. The project will test a professional learning model that (1) integrates the theoretical principles of culturally relevant/responsive pedagogy with best practices in science education and (2) prepares teachers to use three evidence-based practices: culturally responsive classroom management (CRCM), facilitated discourse, and anchoring.

Research Questions

We hypothesize that teachers who participate in the *SCI-Bridge* professional learning model will show significantly higher scores on instruments designed to capture culturally relevant/responsive teaching practices in science instruction. The research design examines components of the model hypothesized as critical for improvements in practice (CRCM, discourse, and anchoring). The project also explores predictions on the best pathways for teachers to learn the innovative model. This study examines the following research questions:

1) To what extent do preservice and inservice teachers' beliefs about, and practices toward, infusing culturally relevant practices into science instruction change by participating in the *SCI-Bridge* model training?
2) Under what conditions do preservice and inservice teachers evidence the most change in belief and practices? (i.e., What are the factors, or conditions by which, teachers improve/change the most?) What is the association or contribution of instructional practice component (CRCM, discourse, anchoring) to the overall effectiveness of the *SCI-Bridge* model? Specifically:
   - How do CRCM strategies support *SCI-Bridge* implementation?
   - Does discourse change from horizontal to vertical patterns?
   - What variations in horizontal patterns support *SCI-Bridge* model?
   - How does anchoring evidence in teachers' instruction?

The study utilizes a mixed methods design that incorporates the sociocultural and communities of practice theory base in selection of data sources and analytic strategies.

Context of the Study

The study involves a partnership between Title I STEM-certified schools in one local urban school district and a graduate level teacher certification program at a local Research I university in the Southeast region of the United States of America. The district involved serves primarily Black students (72%) and children from impoverished communities (68.78%). The study will involve 30 preservice teachers and 20 inservice teachers over a two year period.

Project Activities

Professional Development Series: All participants will take part in a *professional development series* designed to introduce the *SCI-Bridge* model, key practices, and inquiry-based science practices.

Summer Science Academy: All teachers will participate in a *summer science academy*. The academy is designed to engage the teachers and PK–5 students in inquiry-based, curriculum-integrated, culturally responsive/relevant science instruction and provide teachers with a strong foundation from which to strengthen their use anchoring, facilitated discourse, and CRCM.

Clinical Practice/Communities of Practice: The practices of preservice teachers will be examined during *clinical practice*. During this time, preservice teachers will work with mentor teachers who provide coaching in culturally responsive instructional and management skills as well as best practices in science instruction. Inservice teachers' use of culturally responsive/relevant practices will be examined through online *communities of practice* (CoPs). The CoPs provide teachers with (1) opportunities for implementation, reflection, and refinement and (2) valuable support that balances the teacher's need for collegial learning with the scarcity of time.

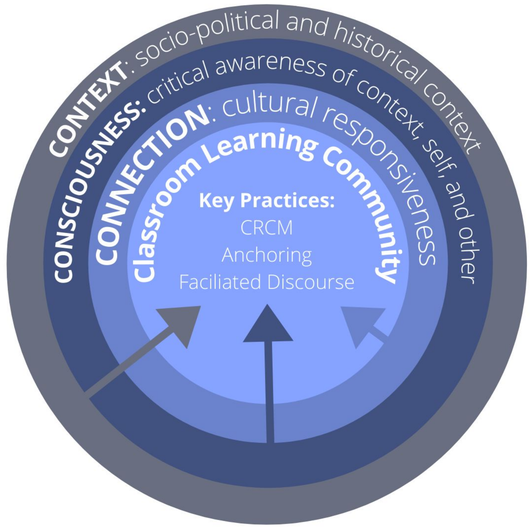

Figure 1. The SCI-Bridge Conceptual Model

The SCI-Bridge Model

Foundational Components
The *SCI-Bridge* model suggests a connection between the educational *context* , the *consciousness* of the members of a community, and the *connections* between individuals in the creation and maintenance of the learning community. The model assumes that these foundational components work in concert to limit or enhance a teacher's ability to effectively implement culturally responsive practices.

Foundational (Key) Practices
Three practices serve as the mechanism for the actualization of the *SCI-Bridge* model - *culturally responsive classroom management*, *contextual anchoring*, and *facilitated discourse*. These practices interact with each other in complex and dynamic ways to support the development of students' academic excellence, cultural competence, and critical consciousness. They represent *examples* of culturally responsive practices and do not describe the breadth of culturally responsive practices available to teachers in the model.

Curricular Framework
The *SCI-Bridge* curricular framework is organized around Bybee's (2009)[1] 5E model as a means of structuring inquiry in the science classroom. Unlike the 5E's, which are traditionally applied solely to science instruction, the *SCI-Bridge* framework is intended for use across the curriculum. This design decision is aligned with the idea that, in order to be effective, culturally responsive pedagogy must be integrated across the scope of a teacher's practices.

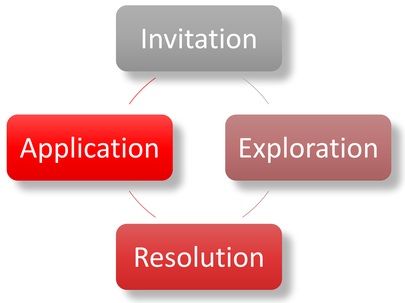

Figure 2. The SCI-Bridge Curricular Framework

Analytic Strategies

Examination of Culturally Responsive Classroom Management (CRCM) Practices
Culturally Responsive Classroom Management practices will be examined using the *Culturally Responsive Classroom Management Self-Efficacy Scale, CRCMSE (*Siwatu, et al., 2017)[2] which asks participants to rate their confidence in performing CRCM tasks.

Examination of Facilitated Discourse
Discourse patterns will be analyzed using two measures. First, document analysis of lesson plans will identify the presence of intentional spaces in the instructional plan for discourse and students' science talk. The study adopts the framework outlined by Bowen (2009)[3] as the analytic strategy for document analysis. Second, the *Culturally Responsive Instruction Observation Protocol, CRIOP* (Powell, et al., 2017)[4] uses field observations to determine evidence of discourse during instruction.

Examination of Anchoring
Two sources of data will inform the presence of anchoring during science instruction. First, document analysis of lesson plans will identify the presence of expected instructional moves in the context of instruction. The *Culturally Responsive Teaching Self-Efficacy-CRTSE* (Siwatu, 2007) will serve as a second data source and will be used to explore the contribution of anchoring in the confidence of science teachers' implementation of culturally responsive practices.

Examination of the SCI-Bridge Model and Classroom Implementation
The online communities of practice (CoP) will serve as an additional qualitative measure of how classroom structures influence the implementation of the *SCI-Bridge* model. CoP sessions will be recorded and transcribed. Analysis of dilemmas with *SCI-Bridge* implementation will be used in design refinement and for usability validation.

Implications

The study contributes to our understanding of effective teacher professional learning models; specifically, as they apply to teachers serving in urban schools and communities. It presents a new model for improving access to quality science instruction while also addressing noted shortcomings in solutions like STEM-certified schools. The case of STEM certification in Title I schools in Georgia is an example of what Thwaites (2015)[5] describes as a "spectacle," in which teachers (and students) perform the roles of spectators. The *SCI-Bridge* project directly responds to the "spectacle" phenomenon by designing and developing an instructional model that can direct STEM certified schools to take advantage of the infrastructure and curriculum. In addition to the instructional model, the project also provides guidance regarding the possible learning pathways for preservice and inservice teachers built from theories of learning and communities of practice. Finally, the research extends the current conversations and knowledge base on equity-based science instruction for economically, culturally, and linguistically diverse student populations.

Image 1. Teachers and students at an earlier iteration of the Summer Science Academy

Contact

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